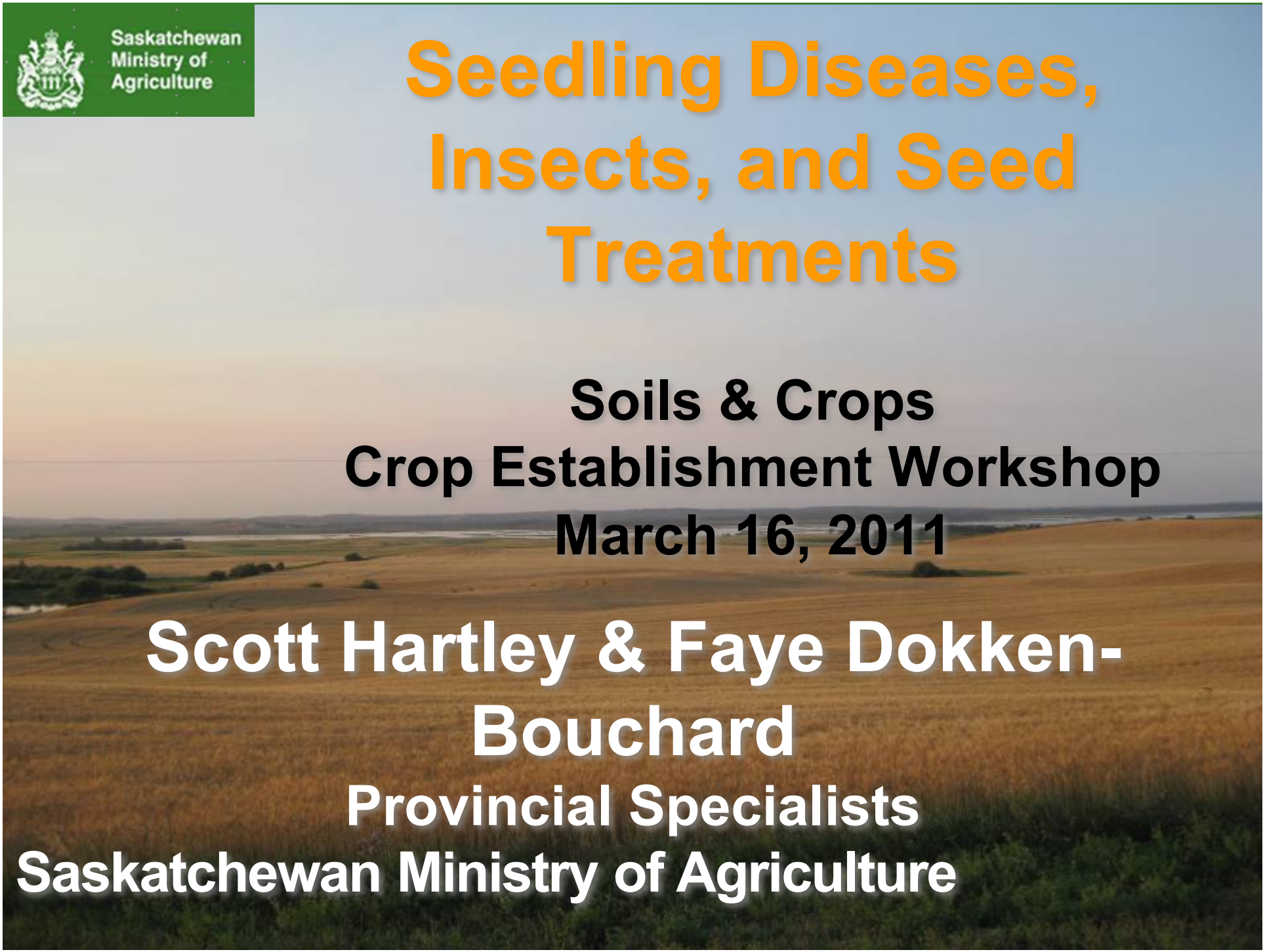

Seedling Diseases, Insects, and Seed Treatments

Soils & Crops
Crop Establishment Workshop
March 16, 2011

Scott Hartley & Faye Dokken-Bouchard
Provincial Specialists
Saskatchewan Ministry of Agriculture

Saskatchewan Ministry of Agriculture

Seedling Diseases & Seed Treatments

Faye Dokken-Bouchard

Co-Author:

Kelly Turkington, AAFC

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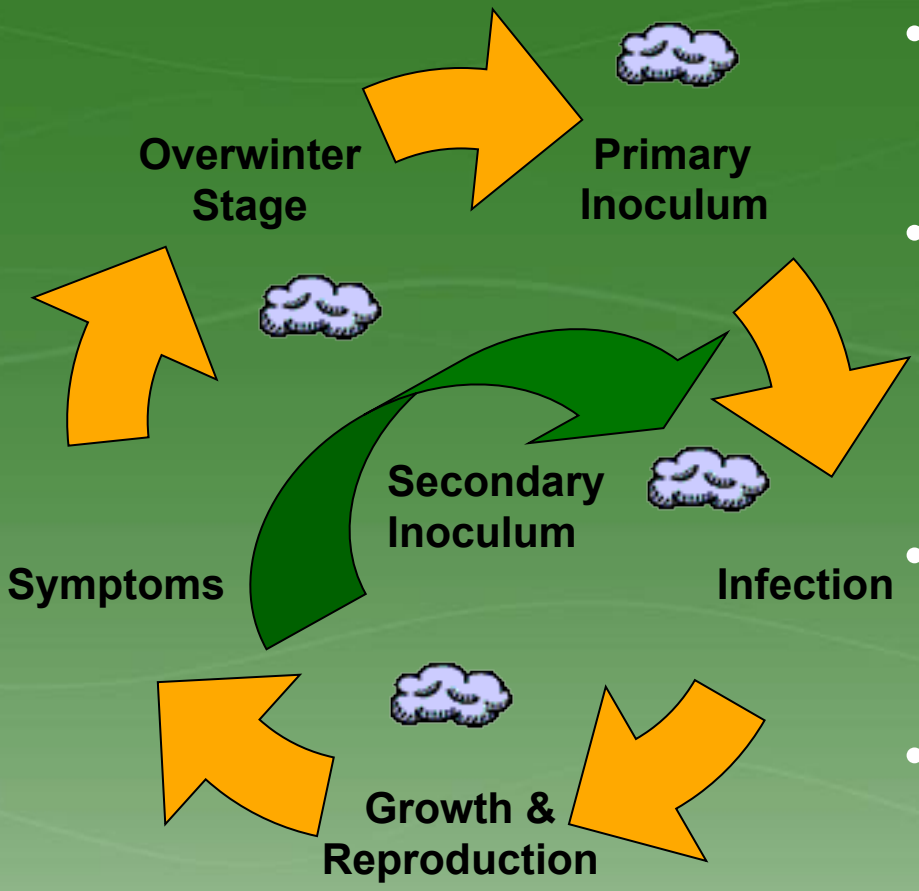
Fungal Facts: why do we see more disease in wet years?



- Most plant diseases occurring in western Canada are caused by fungal organisms.
- Fungi may live as saprophytes (break down dead material) or pathogens (infect/feed on living hosts) or both (opportunistic).
- In general, most fungi like warm, moist conditions and rich nutrient sources.
- Excess moisture can also affect plant susceptibility to disease (through stress or length of susceptible growth stages).

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Seedling Health

- Environmental Stress - Yellowing
  - Roots need oxygen. When soil is saturated, air pores in the soil fill with water causing roots to function poorly.
  - Cool growing conditions slow seedling metabolism.
  - Lack of sunshine causes plants to turn pale green and yellow (reduction in photosynthesis).
  - May promote disease (stress).

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Seedling Diseases

- Generally symptoms often involve yellowing, wilting, stunting or death. Seeds may fail to germinate, seedlings fail to emerge, root/stem decays. Usually scattered or in patches rather than even across field.
- Seedling disease complex includes: seed rots, root rots, crown rot, pre- or post-emergent damping-off, and seedling blights.
  - These terms may be used to describe diseases or symptoms; associated pathogens may overlap (eg. *Fusarium* spp., *Rhizoctonia solani*, *Pythium* spp., *Botrytis cinerea*, *Cochliobolus sativus*)

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Diagnostics

- Various pathogens can cause seedling diseases. While certain pathogens may cause key symptoms, the only way to determine the cause for sure is to send a sample to a lab.
  - Eg. Ministry of Agriculture's Crop Protection Laboratory in Regina
  - Quality of sample is very important to differentiate saprophytes from pathogens (timely scouting, sample collection, testing).
  - May not make a difference at the time, but could alter management decisions next time (eg. seed treatment selection).

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Soil-Borne Pathogens

- Truly soil-borne pathogens exist as either:
  - Specialized resting structures (eg. sclerotia); or
  - Thick-walled spores or hyphae (eg. clubroot resting spores, downy mildew oospores, *Rhizoctonia*).
- Residue-borne pathogens survive on plant material as it is breaking down.

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Seed-Borne Pathogens

- Disease is considered seed-borne if:
  - Seed surface is contaminated by spores or mycelium;
  - General contaminants are present, such as specialized pathogen resting structures;
  - Superficial infection of the seed coat and floral structures; or
  - Internal colonization of seed or embryo infection.
- Consider rate of seed-to-seedling transmission of diseases:
  - Is relationship 1 to 1 (unlikely)? Less than 1 to 1 (likely, eg. *Ascochyta* spp. seldom >10%)? Greater than 1 to 1 (possible, eg. *Botrytis cinerea*)?

Crop	Disease (Pathogen)	Threshold on Seed	Action if Over Threshold	Seed Treatment Options*
All Pulses	Seed rot & damping off (*Pythium, Fusarium, Rhizoctonia,* and/or *Phytophthora* spp.)	N/A (soil-borne)	Use seed treatment* IF: history of disease; seeding under cool-moist conditions; or if planting: kabuli chickpeas, low-tannin lentils, damaged or cracked peas.	Agrox Apron FL Allegiance FL Biological Controls? RootShield
	Seed rot & seedling blight (*Botrytis + Sclerotinia + Fusarium*)	10%	Use seed treatment*	Apron Maxx RTA Cruiser Maxx Pulses Thiram 75WP Trilex AL Vitaflo 280

*Not all seed treatments listed are registered on all pulse crops. See 2011 Guide to Crop Protection.

Crop	Disease (Pathogen)	Threshold on Seed	Action if Over Threshold	Seed Treatment Options*
Chickpea	Ascochyta blight (*Ascochyta rabiei*)	0.3%	Do not use as seed	Apron Maxx RTA Crown Cruiser Maxx Pulses
Lentil	Ascochyta blight (*Ascochyta lentis*)	5%	Use seed treatment*	
		10%	Do not use as seed	
	Anthracnose	Not highly seed-borne	Do not use as seed where lentil has never been grown	None registered
	Stemphylium blight	?	unknown	
Field Pea	Ascochyta complex	10%	Use seed treatment*	Apron Maxx RTA Cruiser Maxx Pulses Vitaflo 280

*Not all seed treatments listed are registered on all pulse crops. See 2011 Guide to Crop Protection

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Fusarium in Seed

- Fusarium in Cereal Seed
  - Not always because of FHB (ie/ occurs without bleached spikelets and damaged kernels
  - Saprophytic *Fusarium* grows late season in wet weather (ie/ may not develop symptoms)
  - Contamination may still result in:
    - Reduced germination
    - Seedling blights
    - Mycotoxin production


R. Morrall

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Fusarium on Seed -> FHB?

- Infected seed does not cause FHB in that crop, but can decrease emergence and cause seedling blight and introduce the pathogen for future FHB infections.
- Fusarium Head Blight (FHB) is caused by spores blowing and splashing off crop residue.

<table>
<tr><th>DISEASE
Pathogen</th><th>THRESHOLD</th><th>ACTION</th><th>SEED TREATMENTS AVAILABLE</th></tr>
<tr><td rowspan="5">SEED-BORNE FUSARIUM in wheat and barley</td><td colspan="2"><u>F. graminearum-infected seed:</u>
Do not bring seed into regions where F. graminearum is NOT common, unless the seed has been tested.</td><td rowspan="6">Armour®
Charter RTU® / Charter®
Cruiser Maxx Cereals®
DB-Red L®
Dividend XL RTA®
Gemini®
Maxim 480FS®
Rancona Apex®
Raxil MD®
Raxil T®
Vitaflo 280®</td></tr>
<tr><td>>5%</td><td>Use other seed source</td></tr>
<tr><td>2-3%</td><td>Use seed treatment</td></tr>
<tr><td colspan="2"><u>Other Fusarium species-infected seed:</u>
Only use seed with strong germination as emergence may be reduced if seed has high levels of Fusarium.</td></tr>
<tr><td>>5%</td><td>Use seed treatment</td></tr>
<tr><td>SEED ROTS SEEDLING BLIGHTS COMMON ROOT ROT</td><td colspan="2"><u>Soil- & residue-borne Cochliobolus & Fusarium:</u>
These pathogens can infect seed; but in this case are soil- or residue-borne.
Seed treatments are effective at the seed and germination stages, but will only provide <u>suppression</u> of common root rot and Fusarium crown rot of older plants.</td></tr>
</table>

DISEASE Pathogen	THRESHOLD	ACTION	SEED TREATMENTS AVAILABLE
PYTHIUM SEED ROT & DAMPING OFF	*Pythium* is primarily soil-borne and is not tested for at seed testing labs. *Pythium* seed rots and damping off are of most concern in the spring, in low-lying areas or poorly drained soils, and/or where there is high moisture.		Cruiser Maxx Cereals® Dividend XL RTA® Gemini® Raxil MD® Raxil T® Vitaflo 280®
NET BLOTCH (barley) ***Pyrenophora teres***	Seed-to-seedling transmission can be a source of disease in fields with no barley residue (ie/ longer rotations) – seed infection is possible. Net blotch spreads through airborne spores, therefore if introduced, it will spread more quickly than diseases with rain-splashed spores.		Vitaflo 280® (suppression)
SEPTORIA COMPLEX (wheat & barley)	Primarily residue-borne, but may be seed-borne. Seed testing labs do not test for this disease. Consider seed treatment if unsure. Seed treatments will not protect against leaf spots and glume blotch later in the season.		Dividend XL RTA® (wheat & barley) Raxil T® (wheat) Vitaflo 280® (wheat)

DISEASE Pathogen	SEED TREATMENTS AVAILABLE
LOOSE SMUT <u>Synonyms:</u> True loose smut, common loose smut Barley: *Ustilago nuda* Wheat: *U. tritici*	Armour® Charter RTU® / Charter® Cruiser Maxx Cereals® Dividend XL RTA® (*wheat only)* Gemini® Rancona Apex® Raxil MD® Raxil T® Raxil WW® Vitaflo 280®
COVERED SMUT Barley: *U. hordei* **FALSE LOOSE SMUT** Barley: *U. nigra* Oat: *U. hordei* **COMMON BUNT** Wheat: *Tilletia* spp.	*Also:* DB-Red L®

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Canola Seed Treatments

- Seed-borne blackleg:
  - Acceleron
  - Gaucho CS FL
  - Helix XTra
  - Prosper FL/FX
- Rarely more than 2% of canola seed will be infected with blackleg, but pathogen (risk for spread of races) may be dispersed to through seed.
- Infected seed can give rise to infected seedlings, which form lesions that produce secondary inoculum: pycnidia->conidia.

- *Pythium* seed rot and damping-off:
  - Acceleron
  - Gaucho CS FL
  - Helix XTra
  - Prosper FL/FX
- Seed rots and seedling blights:
  - All of the above
  - Maxim products

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Seed Treatments

- Contact/Preventative Activity
  - Need to be on the seed prior to pathogen arrival to prevent spore germination or kill spores as they germinate
  - Good coverage is critical for control
- Systemic/Curative Activity
  - May kill pathogen after infection
  - Required for infections that are within the seed (such as loose smut)

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Advantages of Seed Treatments

- Economical and relatively easy to use.
- Simultaneous protection against various seed and soil-borne disease issues as well as insects.
  - BUT know what organisms you are targeting to get the best results (know your field & check the labels).
- Reduce potential for introducing a pathogen into a field via infected seed.
- Small amount of chemical used per unit of field area compared to other chemicals.

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Disadvantages of Seed Treatments

- Broad spectrum activity and complete disease/insect eradication are not possible.
- Fungicides tend to move with xylem (up, transpiration) not phloem (down, like some herbicides) if at all, so young root tissue will have less protection than young seedling tissue
- Won't always make a significant difference every time (insurance) and activity beyond a couple of weeks and beyond the seedling stage is limited.
- Effective application: challenge to achieve proper rate and uniformity of coverage.
- Little opportunity for comparison (not convenient to leave a check strip during seeding).

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Seed Treatments

- Seed treatments will not save a poor seed lot with poor germination, damaged seed, poor vigour, or very high disease.
- Seed treatments will not save a crop with a short rotation or poor agronomic practices.
- Best results? Use clean, healthy, vigorous, intact seed in combination with proper seeding depth and good agronomy.

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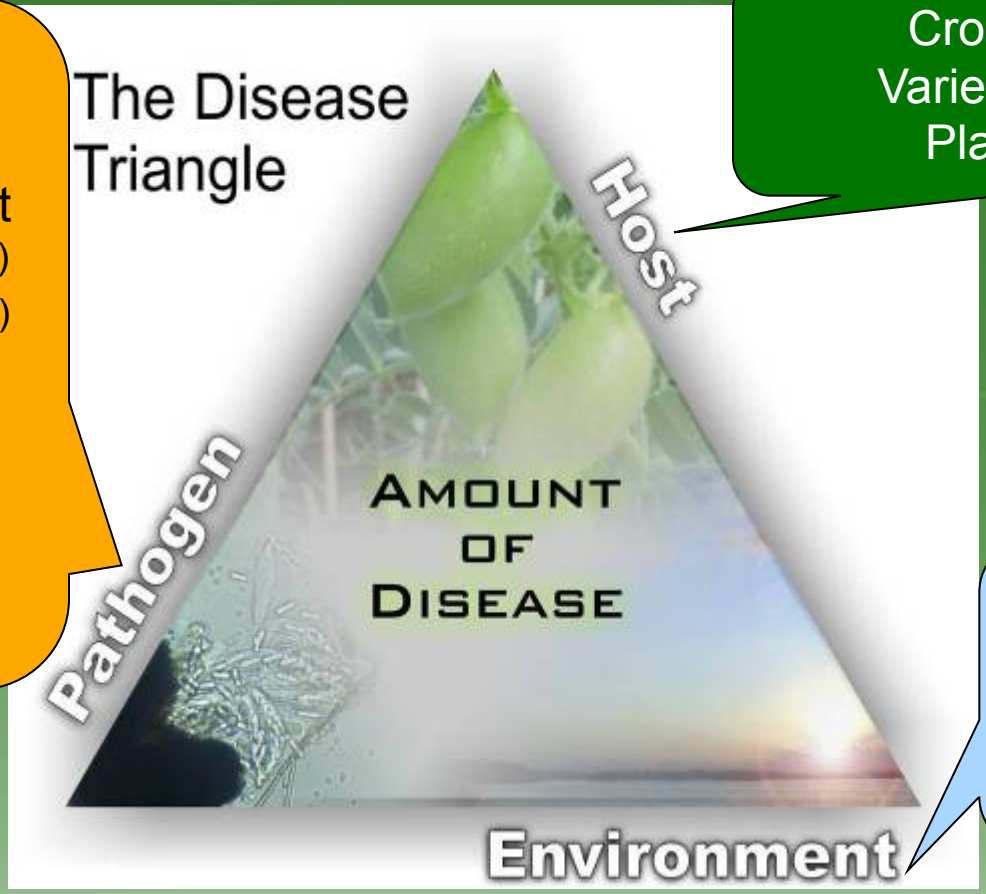
General Disease Forecast for 2011

Disease Trends???

-Seed-borne diseases
-Seedling health
-Sclerotinia stem rot (problem = various hosts)
-Blackleg (maintain R!)
-Foliar diseases (leaf spots, ascochyta, etc...)
-Cereal head infection (Fusarium head blight, ergot)
-New diseases (clubroot)



Crop Rotation
Variety Selection
Plant Health

Most important factor!
Most difficult to predict.

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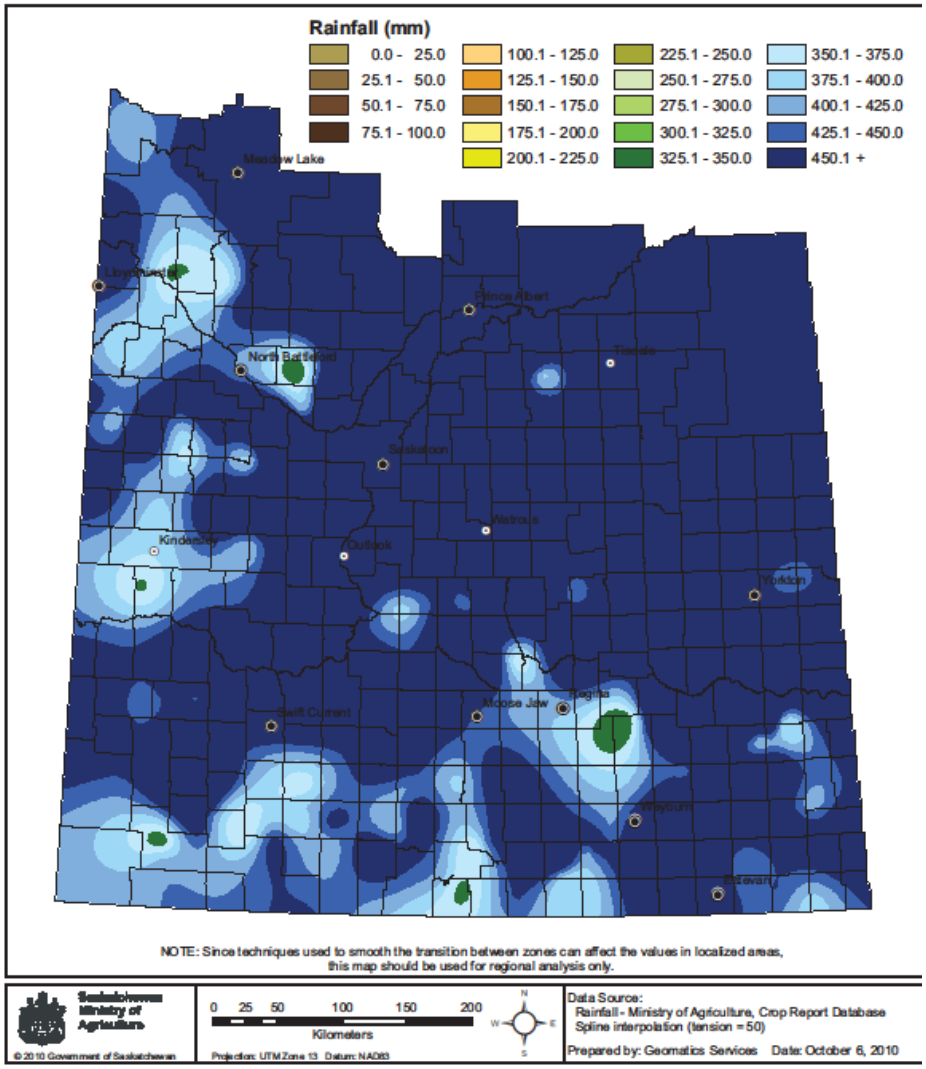
Seedling Insects and Seeding Strategies

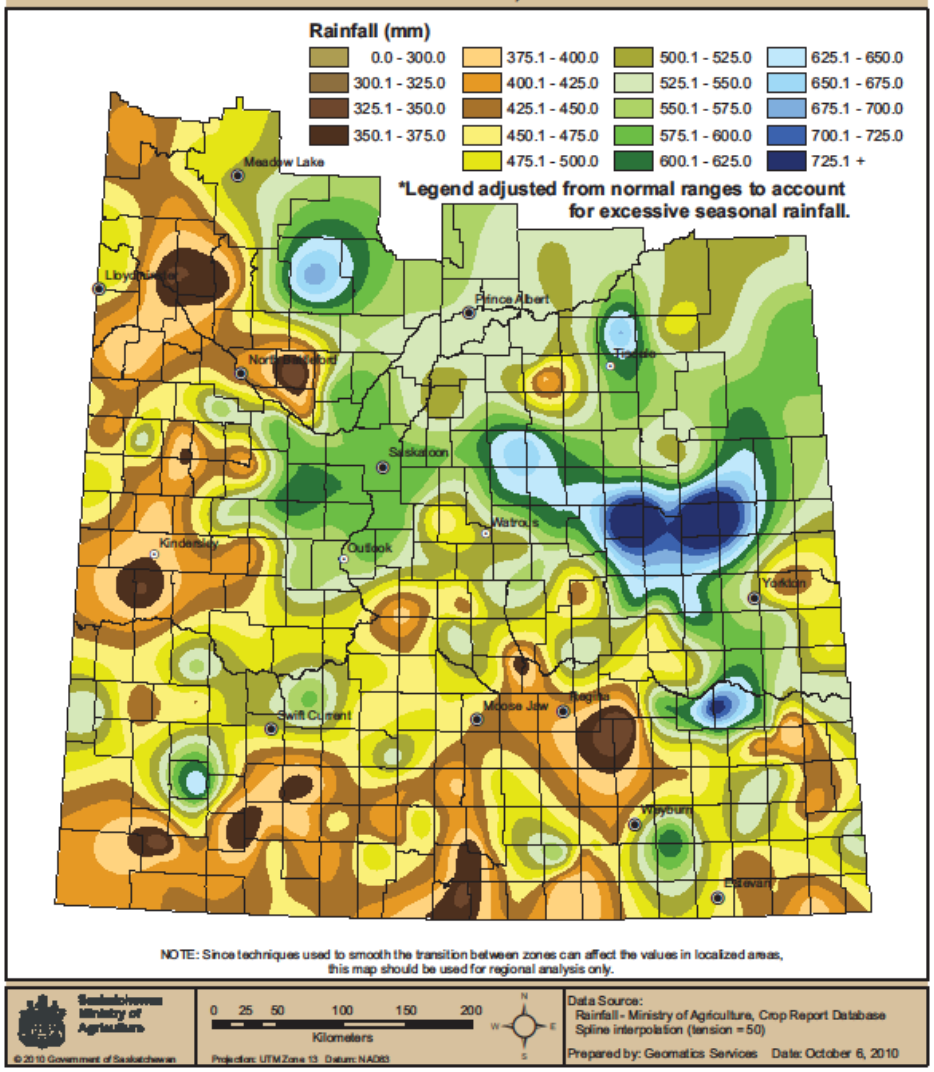
Soils and Crops 2011

Saskatoon

March 16, 2011

Scott Hartley
Provincial Specialist – Insect / Vertebrate Pests
Saskatchewan Ministry of Agriculture





- **Excessive wet conditions negatively affected most insect populations**

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Stored Grain Insects

- Moist harvest in 2010
- **Aeration is the best management option**
  - reduce temperature and moisture
- If moisture content high there is the potential for fungal growth
- Fungus feeding insects are not feeding on sound grain
- Malathion for use in empty grain storage facilities – not recommended if canola is to be stored
- Diatomaceous earth – physically kills active insects
- Fumigation – only by licensed applicators
  - **DO NOT fumigate below +5 degrees C**

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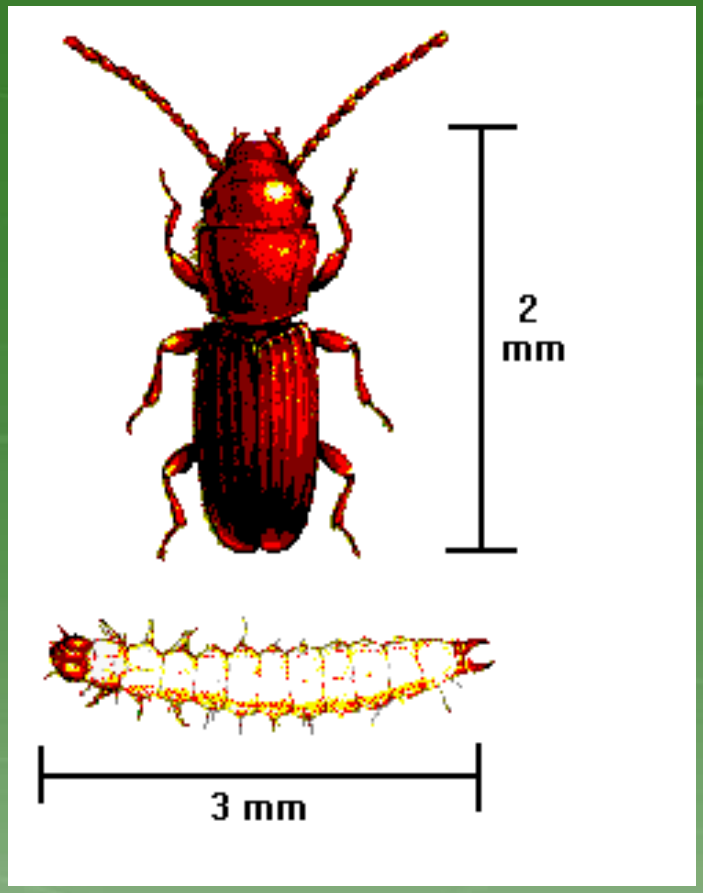
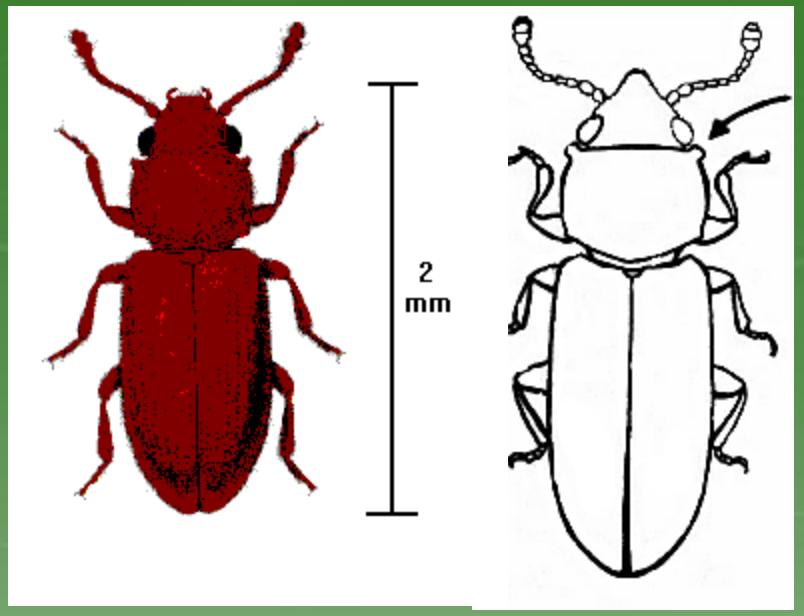
Rusty Grain Beetles vs. Foreign Grain Beetles



Rusty grain beetle



Foreign grain beetle – fungus feeder

- Note clubbed antennae and knobs on front of thorax ("shoulders)

Images – Canadian Grain Commission

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Grain Storage

- Dry and cool down
- DO NOT store canola in bins treated with malathion for at least 6 months

Mites in stored canola
-fungus feeders
-high moisture

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Non-Pests Found in Early Season

Enchytraeds

Tipulidae
– crane fly larvae / leather jackets

(images courtesy of Viterra)

Scarab beetle larvae

Therevidae - stiletto fly larva

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Wireworms

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Wireworms = Larvae of click beetles (Coleoptera: Elateridae)

~370 known species in Canada

~30 economic species

~10% of larvae are known

~ 4 year development, pupation in fall (most Canadian species)

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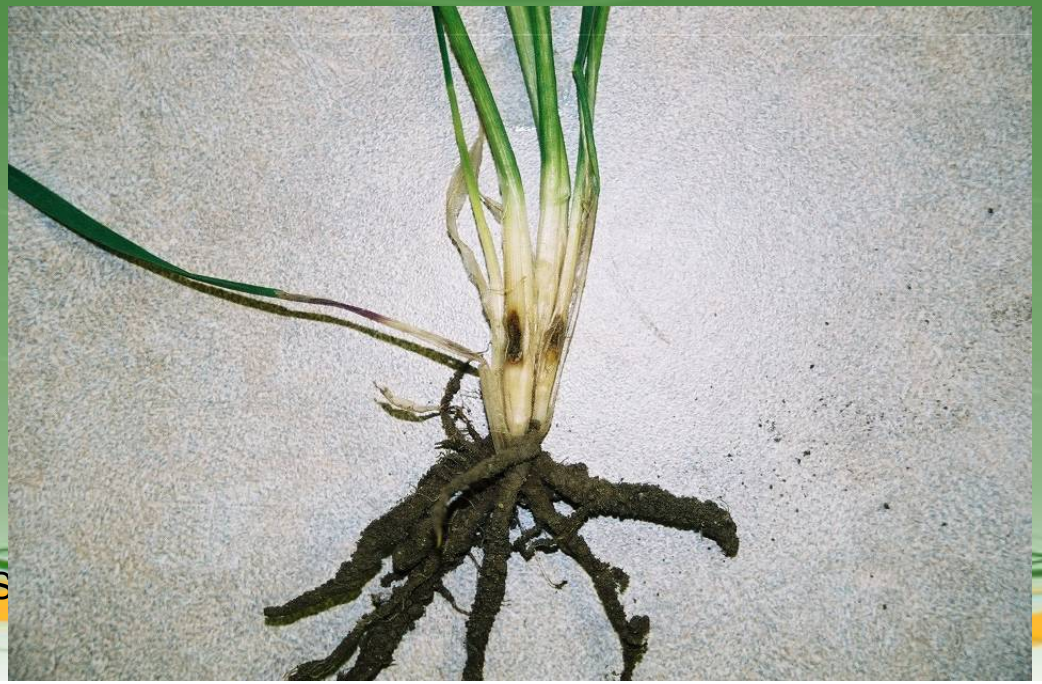
Wireworm damage



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Wireworms

Wireworm control = seed treatment

- thiamethoxam – pulse crops, cereals. Must be applied to seed by commercial seed treaters with closed system facilities
- imidacloprid – cereals – on farm
- phorate – potatoes

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Cutworms

- one of the most important insect pests in 2010

- more than one species – sometimes in the same field

- (AKC – 2010) most cutworm infestations were in canola.

dingy cutworm

- over-winter as larvae
- above ground / foliar feeder

red-backed cutworm

- over-winter as eggs
- below ground feeder

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Cutworm damage

Crops Branch

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Flea Beetles

- increased in spring and fall 2009

2010 – reduced - low populations in Saskatchewan

Spring – Over-wintered adults

Fall – new generation
- best estimate of spring populations

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- **Flea Beetle Species Shift Study**
  - AAFC (Saskatoon) – Increase in striped flea beetles over 6 years of surveys
  - related to ?: - new insecticides
  - biology of the beetle

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Pea Leaf Weevil

Crops Branch

Pea leaf weevil photos courtesy L. Dosdall

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Pea leaf weevil (*Sitona lineatus)* in Peas

- Insecticide Seed Treatments and / or Foliar Insecticides
  - Seed treatment – Cruiser ® Max (thiamethoxam)
  - Foliar – Matador (lambda-cyhalothrin)
- Early scouting is critical
- Threshold Levels for Spraying - “One Notch on the clam leaves per 3 plants prior to the sixth node”
  - AAFC (Lethbridge) – no yield response from foliar applied insecticides

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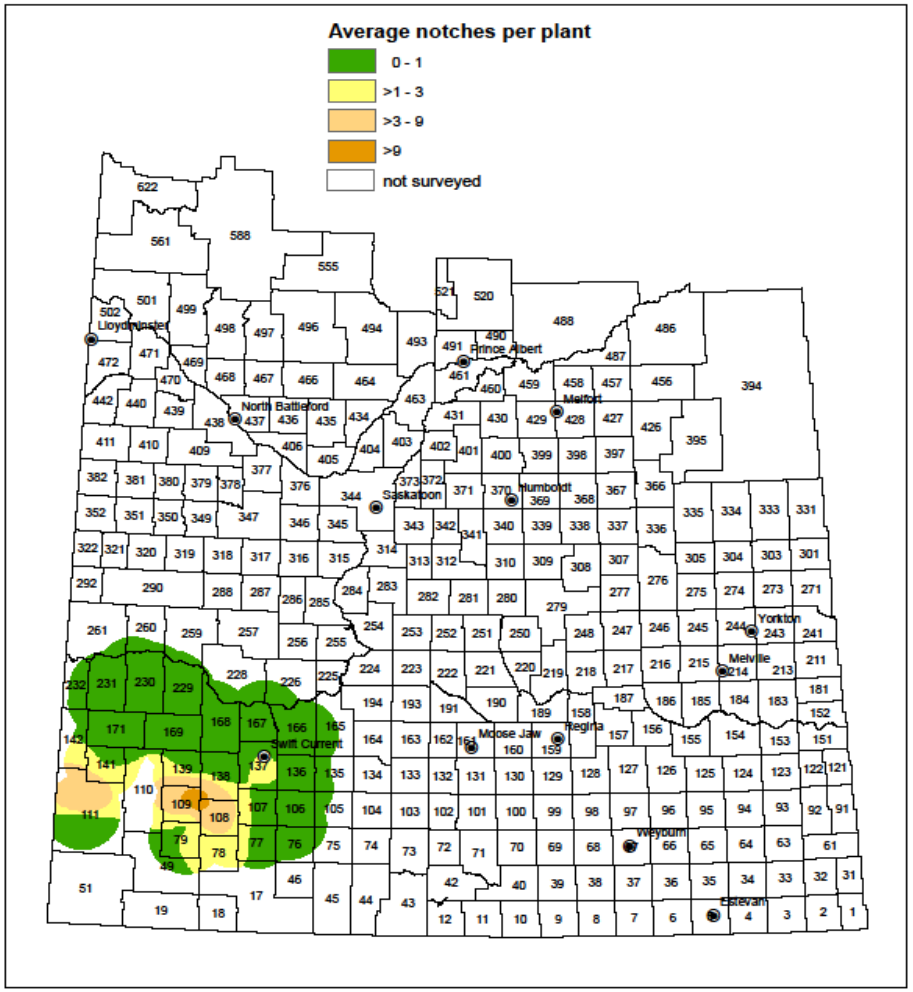
Pea Leaf Weevil Surveys

Saskatchewan Pea Leaf Weevil Survey - 2009



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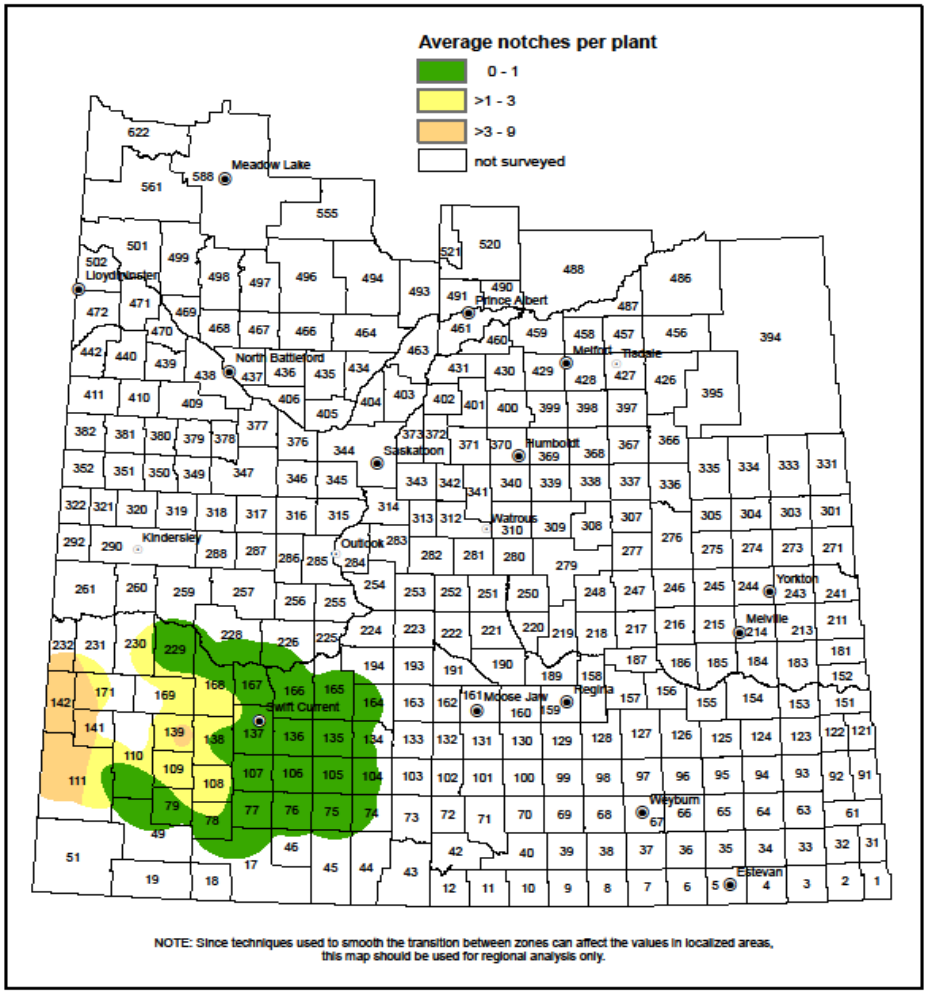
0 25 50 100 150 200
Kilometers

Projection: UTM Zone 13 Datum: NAD83

Data Sources:
Survey data - Agriculture Knowledge Centre and Crop Development Branch

Prepared by: Geomatics Services Date: September 25, 2009

Saskatchewan Pea Leaf Weevil Survey - 2010



NOTE: Since techniques used to smooth the transition between zones can affect the values in localized areas, this map should be used for regional analysis only.

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0 25 50 100 150 200
Kilometers

Projection: UTM Zone 13 Datum: NAD83

Data Source:
Survey data - Agriculture Knowledge Centre and Crops Branch

Prepared by: Geomatics Services Date: September 8, 2010

Diamondback moth

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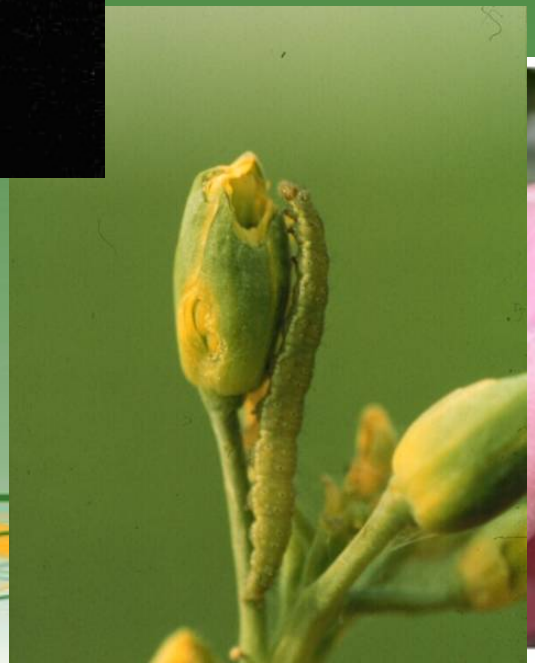
Diamondback moth

- Adult moths are blown in from the south, are present 1 to 2 weeks before larvae
- Monitoring incoming flights
  - Wind trajectories
  - Pheromone baited traps



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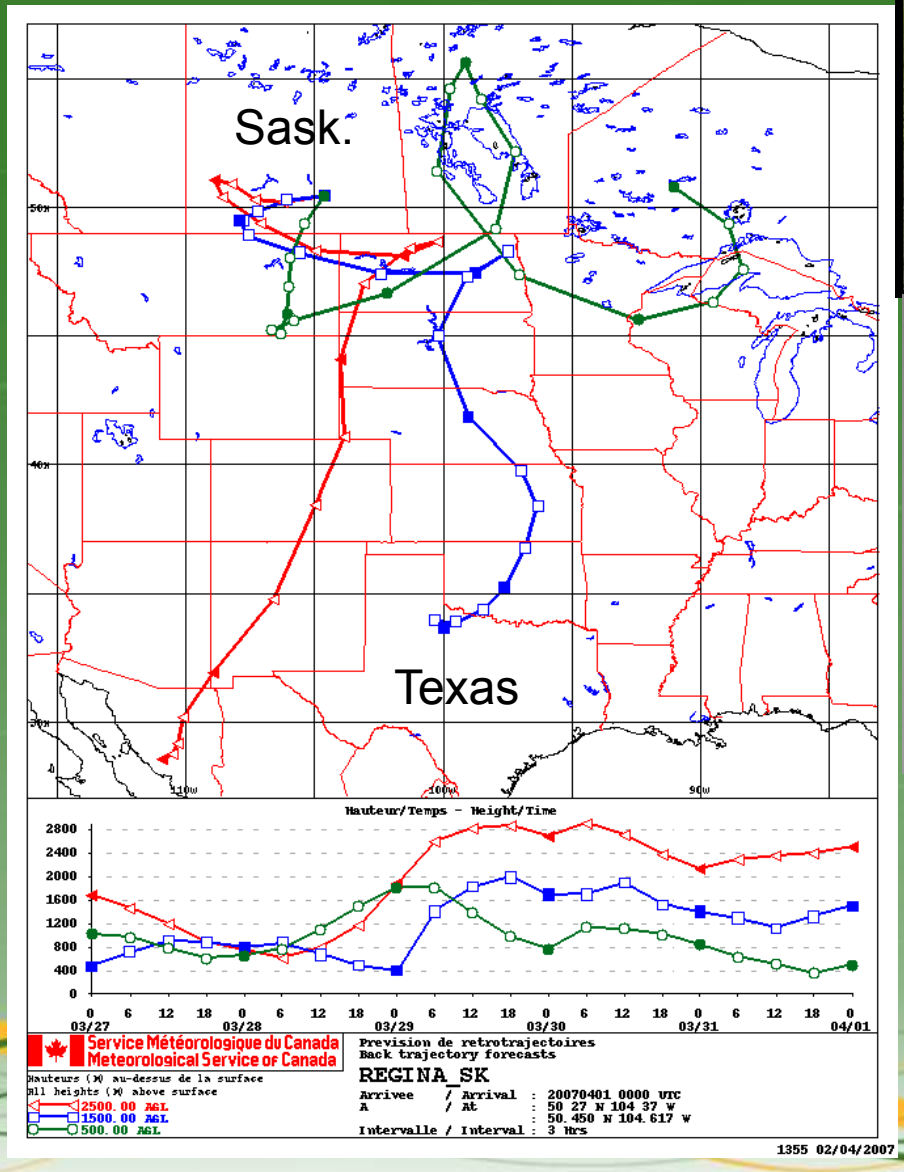
Diamondback moth Monitoring

Wind Trajectories



Pheromone Traps

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Cabbage Root Maggots

- moist conditions favour root maggots
- common in 2008, 2009, 2010
- 2011 – increase seeding rates – no insecticide control options

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Wheat Stem Sawfly

- Spring wheat is primary host

Image – USDA
T. Shanower

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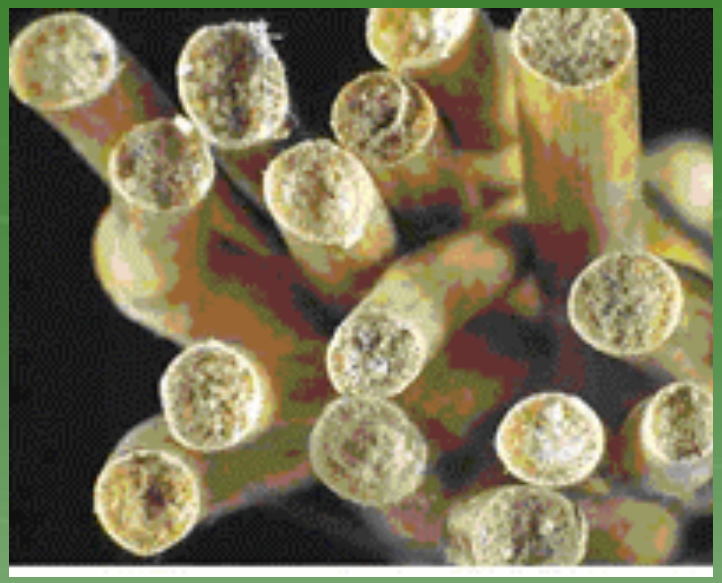
Sawfly Damage



Stem plugged with frass (larval feces) and plant material. (Courtesy – B. Beres, Lethbridge Research Centre, AAFC

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Sawfly Management

- Implement management strategies if
  - 10 – 15% stems cut the previous year
- No registered seed treatments or foliar insecticides
  - No economic benefit shown in research
- Resistant crops – Oats, flax, lentil, canola
- Solid stem wheat varieties – AC Lillian, AC Abbey, AC Eatonia – increased larval mortality

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Wheat midge

Biological control – wasp parasites, natural and introduced species (approx. 2 mm in length)

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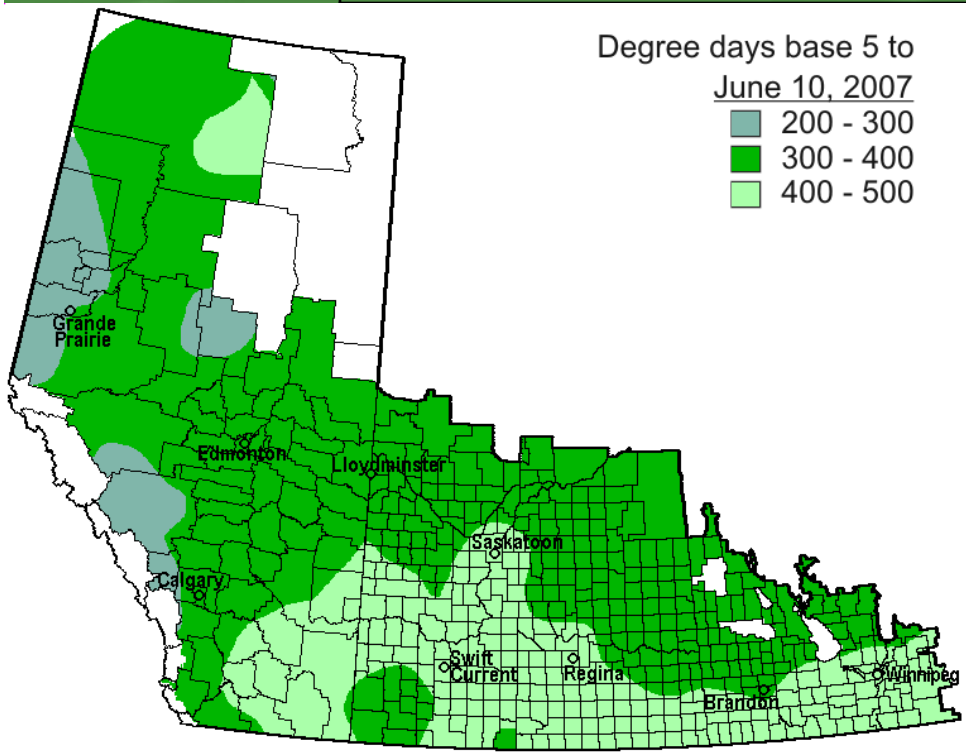
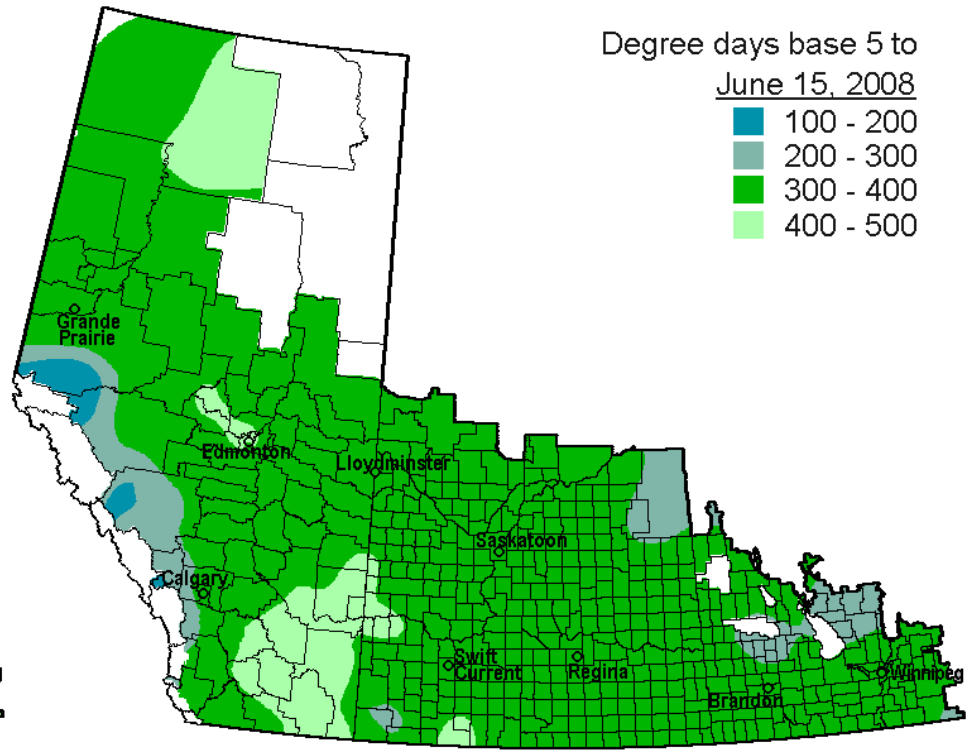
Wheat Midge Development

Example June 15 - 2007 vs 2008

	Emergence*	D° D
	10%	**693** (±39)
=	50%	**784** (±38)
	90%	**874** (±41)

* data supplied by Bob Elliott





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Wheat Midge Management

- Seeding strategies
  - Avoid planting in wheat stubble - favours the buildup of midge populations
  - Seed wheat early
  - Select early maturing wheat varieties
  - Increase seeding rate – uniform maturity
    - reduce tillering
  - Rotation to a non-host crop
    - cereals (barley, oats)
    - broadleaf crops (canola, pulses)

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Wheat Midge Management

- Wheat during the growing season
  - Regular monitoring when crop is in a susceptible stage
  - Susceptible stage – From when the wheat head becomes visible until the crop flowering (anthesis)
  - susceptibility drops dramatically at the onset of anthesis due to natural resistance from the build-up of ferulic acid

Start of susceptibility

Wheat no longer susceptible


AAFC - Saskatoon

Saskatchewan Ministry of Agriculture

Midge Tolerant Wheat

- Sm1 gene – single gene resistance from "Clark" (soft red winter wheat)
- Tolerance Mechanism
  - induced by insect feeding
  - increased Ferulic and p-Coumaric acid in kernel (phenolic acids)
  - Midge larvae nibble on kernel, stop feeding and die
  - Not harmful to midge parasites
  - Phenolic acid levels drop down to normal by harvest

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Managing Crop Resistance

- In crop “refuge” of susceptible wheat (90:10 varietal blends) where small numbers of avirulent midge can survive to mate with virulent midge rather than themselves.
- Most of the resulting progeny will die on resistant wheat
- 2011 – Varietal blends available
  - Three Canadian western red spring and one Canadian western Extra Strong
  - Refer to Saskatchewan Seed Guide

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Wheat Midge Forecast 2011

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

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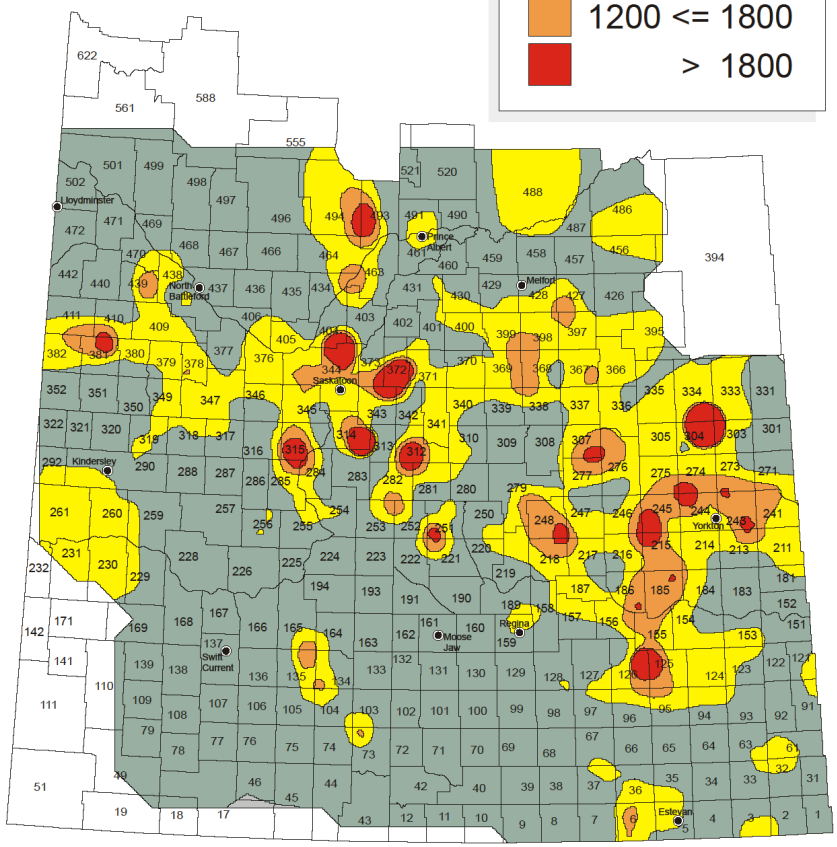
CANADA ~ SASKATCHEWAN Crop Insurance



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Grasshoppers

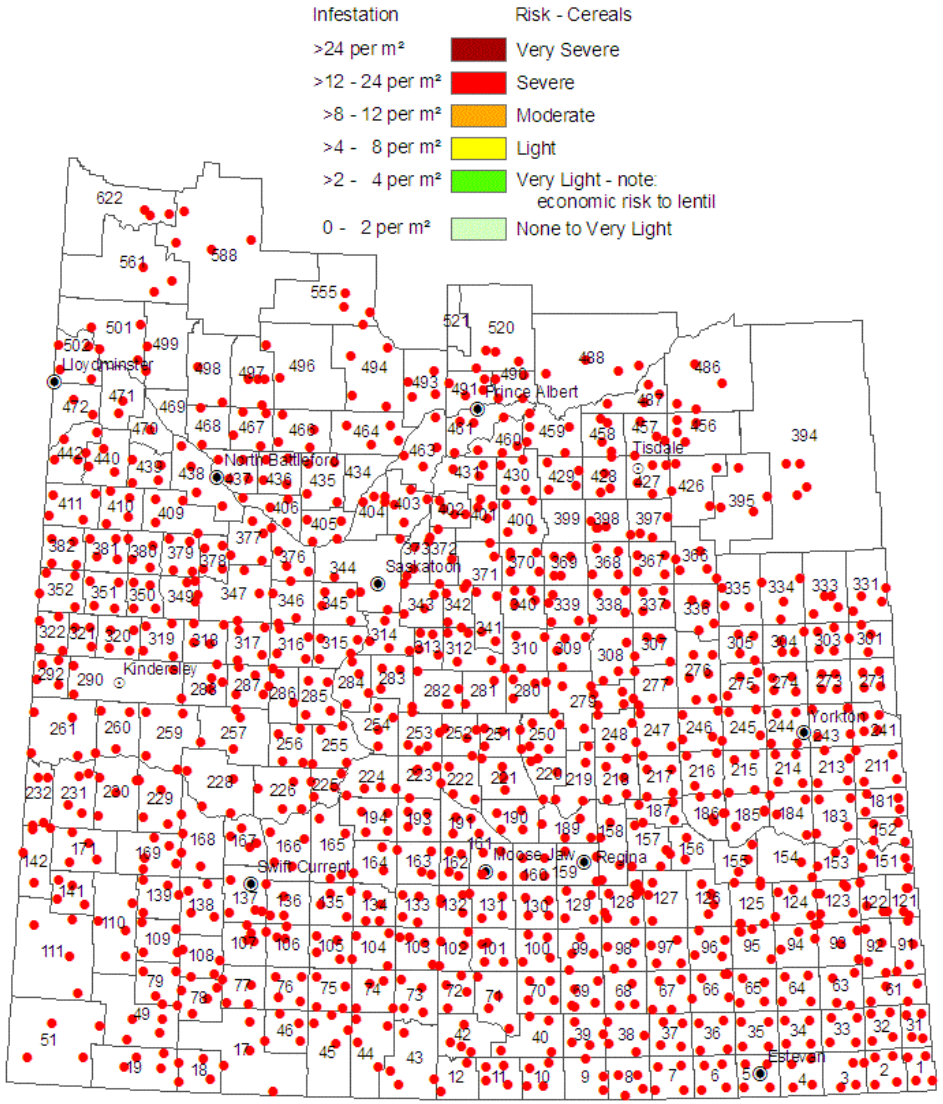
photo - Dan Johnson
Universtiy of Lethbridge

Melanoplus bivittatus (Two-striped)

Saskatch
Ministry
Agricultu

2007 Grasshopper Forecast

based on adult grasshopper counts



NOTE: Since techniques used to smooth the transition between zones can affect the values in localized areas, this map should be used for regional analysis only.

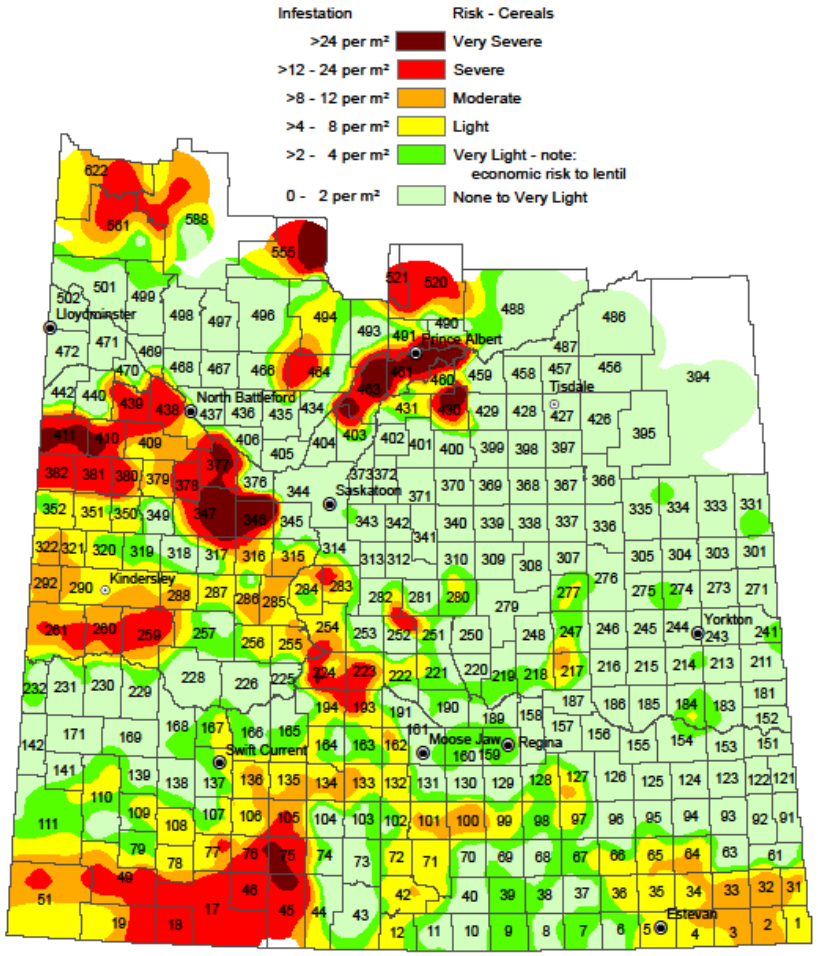
CANADA-SASKATCHEWAN Crop Insurance

Saskatchewan Agriculture and Food

Grasshopper count data - SCIC Field Staff
Base Geospatial Data provided under license to SAF,
© of Information Services Corporation of Saskatchewan
Prepared by: Geomatics Services Date: December 7, 2006

2010 Grasshopper Forecast

based on adult grasshopper counts



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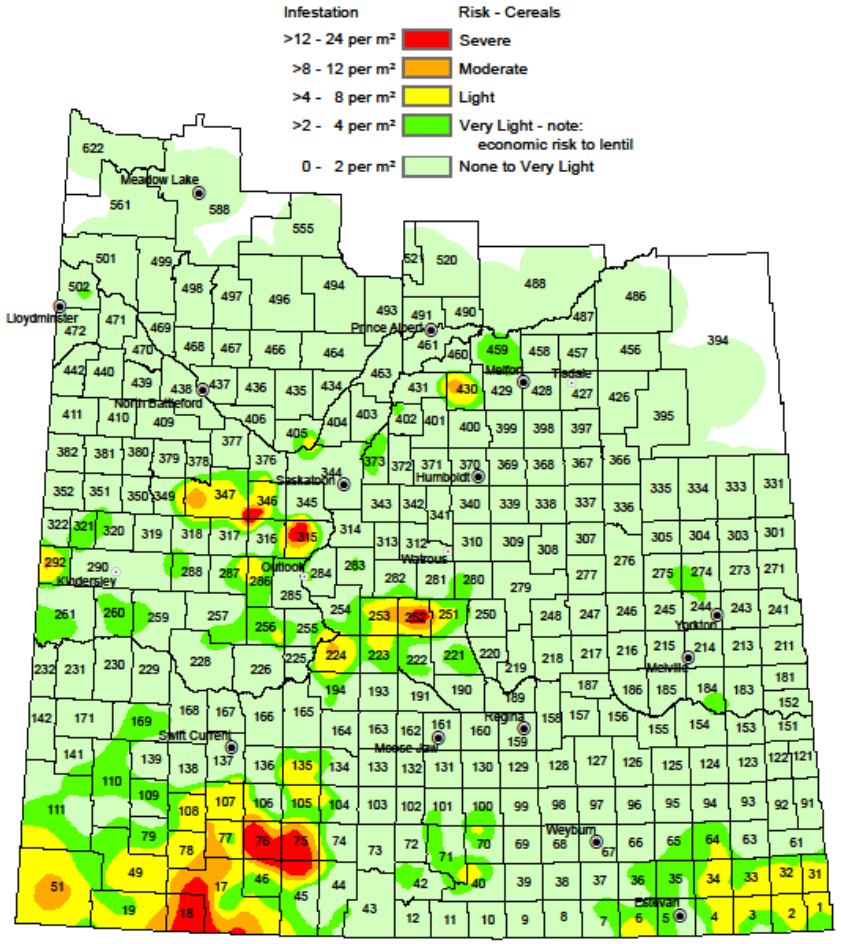
CANADA - SASKATCHEWAN Crop Insurance

Data Source: Grasshopper Count - Saskatchewan Crop Insurance Corporation Field Staff

Prepared by: Geomatics Services Date: October 20, 2009

2011 Grasshopper Forecast

based on adult grasshopper counts



NOTE: Since techniques used to smooth the transition between zones can affect the values in localized areas, this map should be used for regional analysis only.

Saskatchewan Ministry of Agriculture

SCIC Saskatchewan Crop Insurance Corporation

Data Source: Grasshopper Count - Saskatchewan Crop Insurance Corporation Field Staff

Prepared by: Geomatics Services Date: November 29, 2010

Saskatchewan
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Agriculture

Spur-throated = pest species

Saskatchewan Ministry of Agriculture

Melanoplus femurrubrum (DeGeer) Red-legged grasshopper

Saskatchewan Ministry of Agriculture

Non-pest Grasshopper Species

The following indicates **non-pest** grasshoppers:

-with knobs on antenna

-adult early in season

-with red, yellow or orange wings

-any seen before May 25

-any that sing loudly while sitting

-any that crackle when they fly

The club-horned grasshopper is often seen in April and May (no problem).

Saskatchewan Ministry of Agriculture

Management and Control

- Plant less preferred crops (oats, peas) as part of a rotation or as a guard crop
- Early seeding
  - Older plants – less attractive for food and often can withstand more / compensate for hopper feeding
  - Earlier maturity = less attractive for egg laying
- Crop rotation
  - Avoid cereal on stubble with heavy infestations of grasshoppers
- Insecticides – use economic thresholds as guidelines

Saskatchewan Ministry of Agriculture

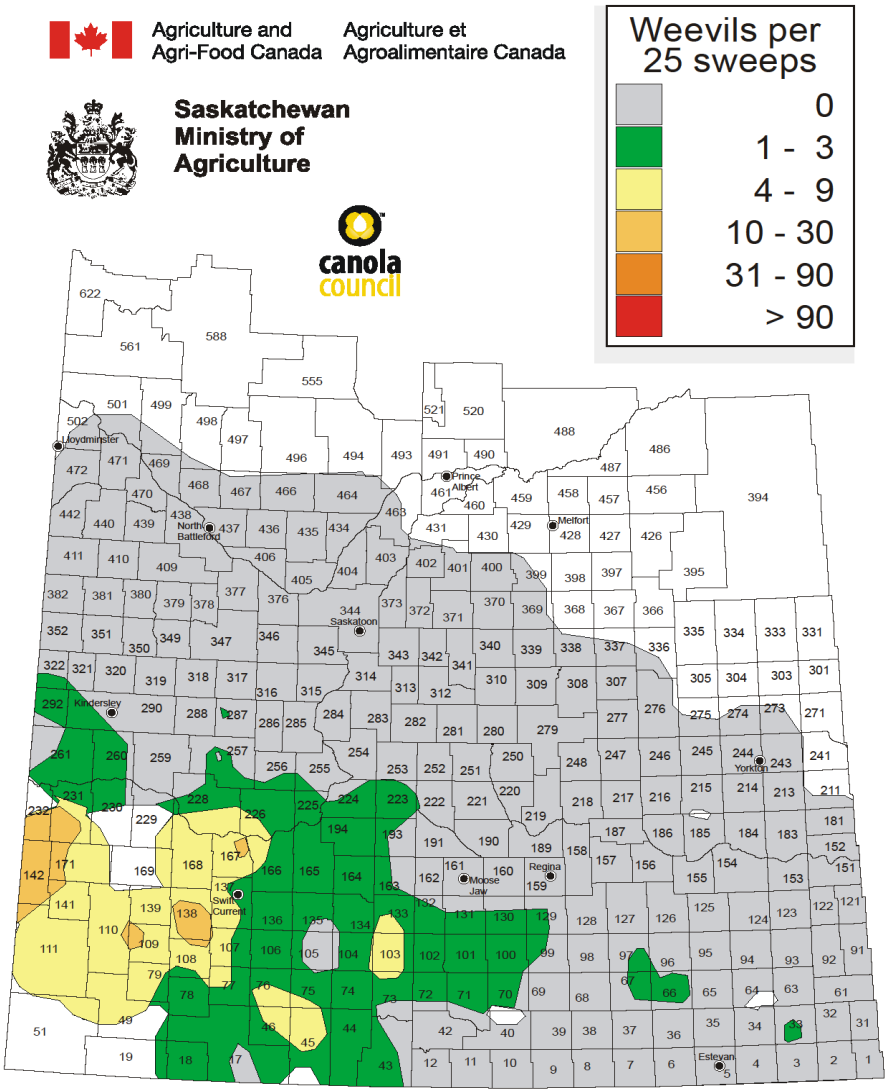
Cabbage Seedpod Weevil

- A beetle with a long snout
- Feeds with mouthparts at the end of the snout
- A serious pest in canola – potentially - some mustard
- Yellow mustard is resistant

Saskatchewan Ministry of Agriculture

Cabbage Seedpod Weevil 2010 Survey

The weevil has continued expansion in distribution – eastward more than north



Saskatchewan Ministry of Agriculture

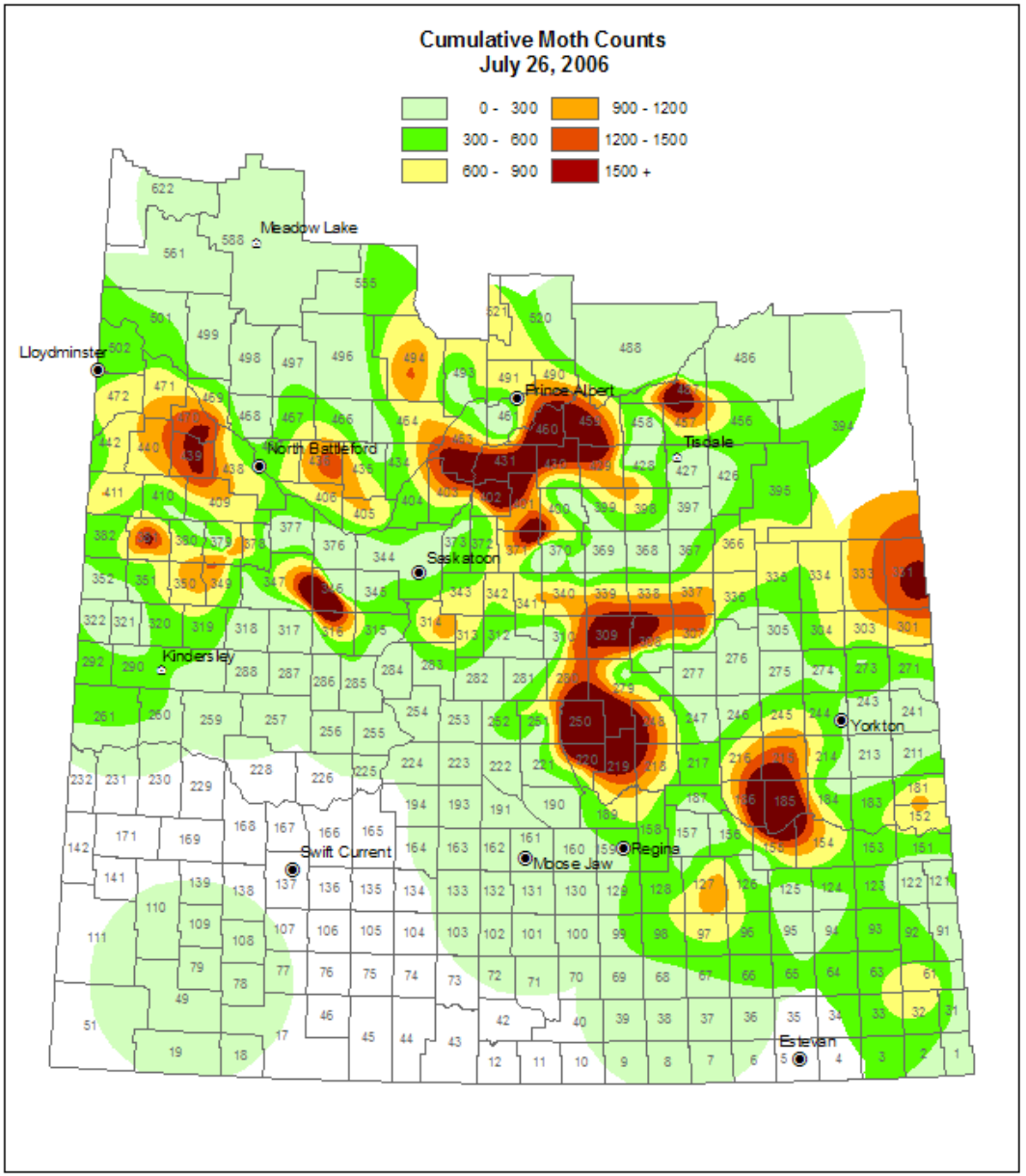
Bertha Armyworm

Saskatchewan Ministry of Agriculture

Pheromone trapping Program

Crops Branch

Bertha Armyworm



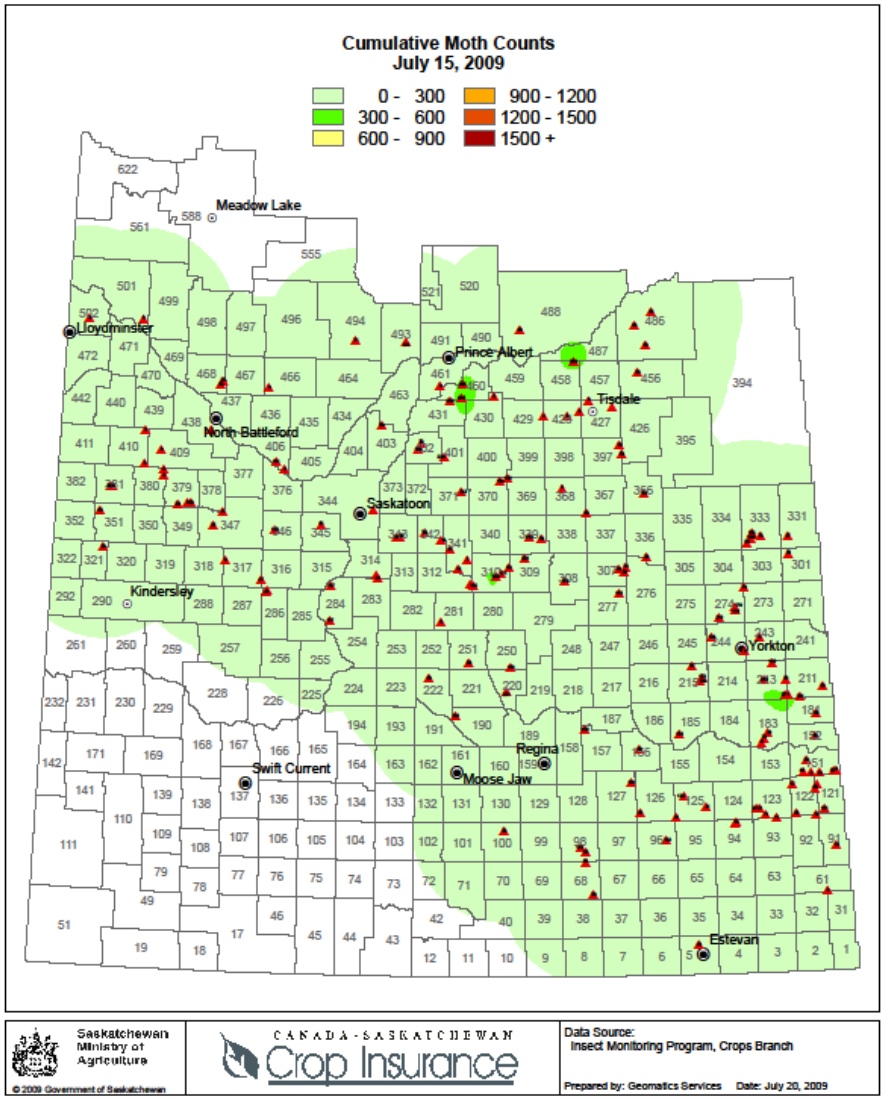
Saskatchewan Agriculture and Food

CANADA-SASKATCHEWAN Crop Insurance

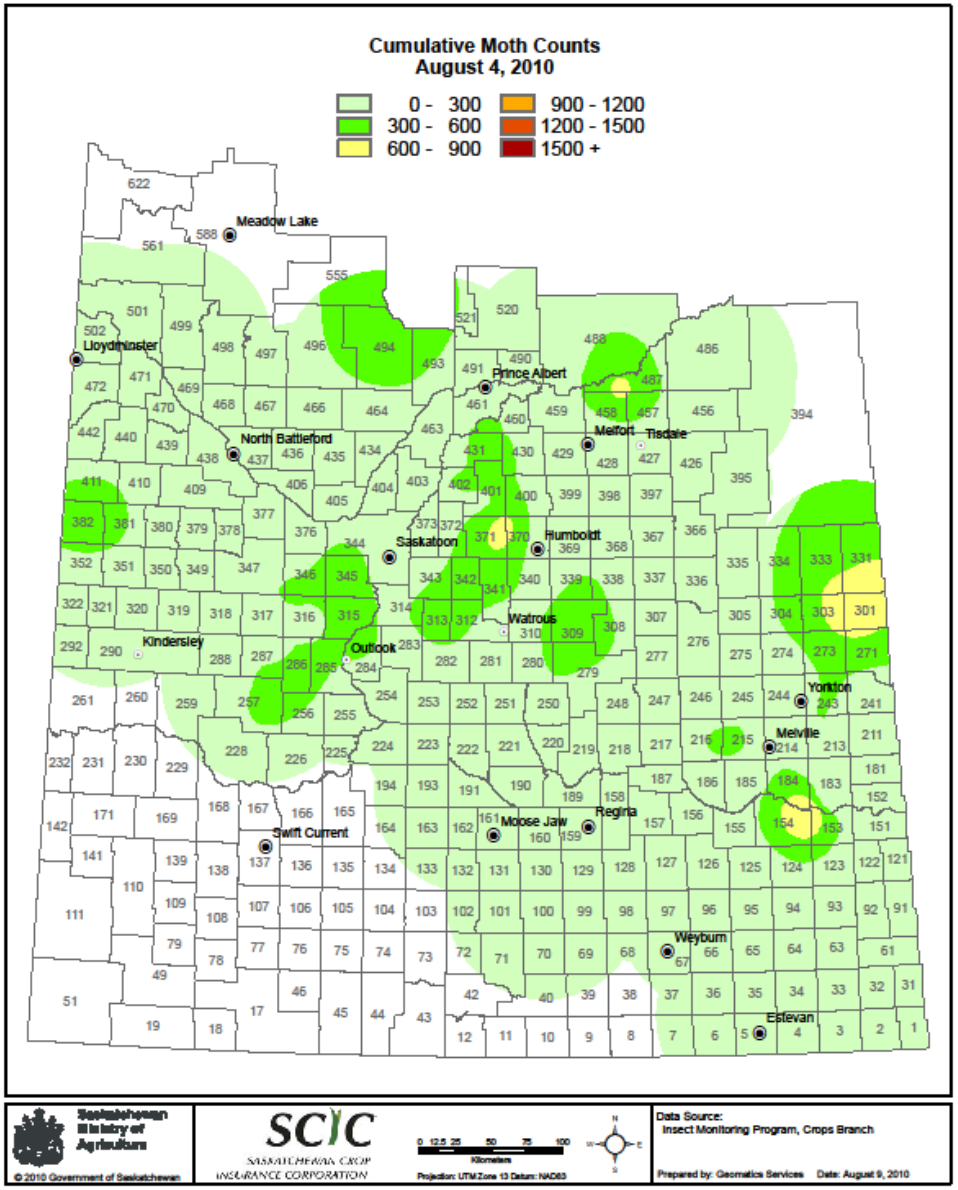
Moth count data - SAF Insect Monitoring Program
Base Geospatial Data provided under license to SAF, © of Information Services Corporation of Saskatchewan

Prepared by : Geomatics Services Date: July 31, 2006

Bertha Armyworm



Bertha Armyworm



2010 - 170 sites / 130 cooperators

Saskatchewan Ministry of Agriculture

The End

Questions?